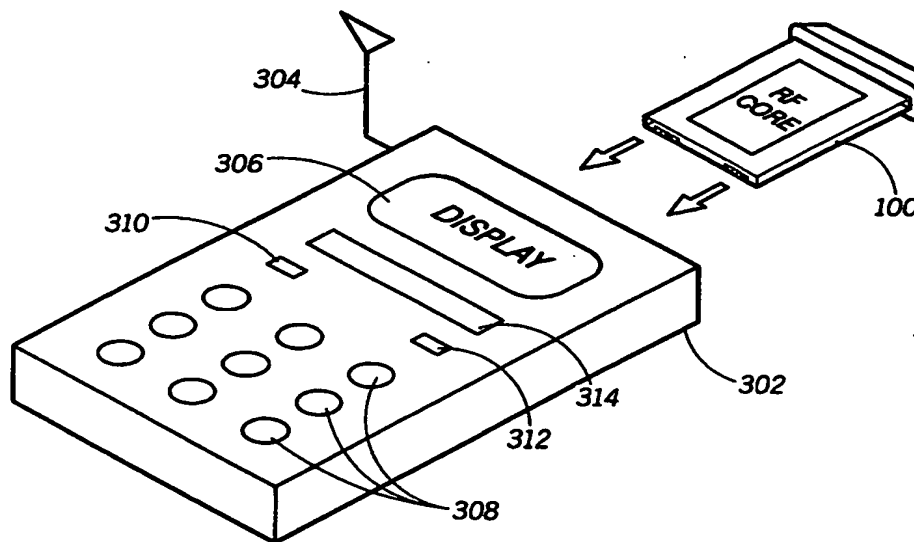


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<p>(21) International Application Number: PCT/US98/14867</p> <p>(22) International Filing Date: 17 July 1998 (17.07.98)</p> <p>(30) Priority Data: 08/959,422 28 October 1997 (28.10.97) US</p> <p>(71) Applicant: MOTOROLA INC. [US/US]; 1303 East Algonquin Road, Schaumburg, IL 60196 (US).</p> <p>(72) Inventors: IVERS, Paul; 12052 Black Forest Court, Lockport, IL 60441 (US). ECONOMY, George; 421 N. Wilshire Lane, Arlington Heights, IL 60004 (US).</p> <p>(74) Agents: COFFING, James, A. et al.; Motorola Inc., Intellectual Property Dept., 1303 East Algonquin Road, Schaumburg, IL 60196 (US).</p>		<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p>Published <i>With international search report.</i></p>

(54) Title: RADIO FREQUENCY (RF) COMMUNICATIONS CORE AND METHOD OF USING SAME



(57) Abstract

A device includes a first housing (102) for mating with a second housing (302). Disposed within the first housing (100) is a modulator (203) and a demodulator (205) that, together with a wireless communication element (204), constitute an RF section to provide communications capabilities. The first housing (102) includes second-housing interfaces (207, 209) for connecting with one or more human interfaces (306-314) and/or functional interfaces (304) disposed on the second housing (302). A controller (201) is also disposed within the first housing (102) and is operably coupled to the human-interface interfaces (207) and functional interfaces (209), and at least one of the modulator (203) or demodulator (205). During operation, the controller selects a particular human-interface mode of operation from amongst a plurality of stored modes of operation to accommodate a particular set of second housing human interfaces and functions.

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RADIO FREQUENCY (RF) COMMUNICATIONS CORE AND METHOD OF USING SAME

5 Field of the Invention

The present invention relates generally to radio/telephone communication systems, and in particular to such systems that depoloy a common radio frequency (RF) communications core module in a variety of form factors for use in such a system.

15 Background of the Invention

Wireless communications are well known and generally provide for an exchange of information between two points without the use of a wireline infrastructure. Examples of such wireless communications include paging, cellular telephony, two-way land mobile radios and wireless modem applications for use with portable computing devices. Each of these applications have unique requirements regarding human interface, functionality required and form factors. By way of example, a conventional pager requires only receive circuitry and is generally limited in size to be wearable by the user. By contrast, a lap top computer has a form factor that is much larger and would typically require both transmit and receive circuitry for wireless communications.

In spite of their differences in functionality, size and form factors, the aforementioned devices share a common need for wireless communications circuitry. This wireless communications circuitry tends to be a predominant factor in the total unit cost of the device being considered. Moreover, users often need to carry several of these devices, and therefore must incur the costs of multiple wireless communication assemblies.

Accordingly, a need exists for a universal wireless communications core that can be used in one or more devices interchangeably. In particular, a wireless communication core that could be interchangeably inserted into a multitude of form factors and enabled thereby for use as a wireless communications tool would be an improvement over the prior art.

10

Brief Description of the Drawings

FIG. 1 shows a radio communications core device, in accordance with the present invention;

15 1; FIG. 2 shows a block diagram of the device shown in FIG.

FIG. 3 shows the device of FIG. 1 and the manner in which it might be inserted into a wireless communications tool, in accordance with the present invention;

20 FIG. 4 shows how the device of FIG. 1 might be employed by a multitude of wireless communication tools; and

FIG. 5 shows a flow diagram depicting the operation of a card radio, in accordance with the preferred embodiment of the invention.

25

Detailed Description of a Preferred Embodiment

The present invention encompasses a device having a first housing, which includes a modulator and a demodulator. 30 The device further includes an interface for coupling to a second housing, and includes a human-interface interface. The device further includes a controller disposed within the first housing and coupled to the human-interface interface, as well as to the modulator and/or the demodulator. 35 According to the invention, the controller is used to select a particular mode of operation from amongst a plurality of stored modes of operation to accommodate a human interface for the second housing. In this manner, the present invention

solves the needs of the prior art by providing a universal communications core that can be used with a multitude of distinct form factors (second housings) having different human interface characteristics.

5

FIG. 1 shows a radio communications core device 100, in accordance with a preferred embodiment of the invention. It consists of a PC card form factor, including a first housing 102 that supports an RF shielded element 108 as well as two
10 interfaces for coupling the first housing to a second housing. These interfaces are referred to herein as the human-interface interface 104 and the functional interface 106. Both interfaces 104 and 106 are physically connected to a second housing interface to allow functionality as a radio
15 communication tool corresponding to a particular form factor, as later described.

FIG. 2 shows a block diagram 200 the functional components found in first housing 102, according to the
20 invention. As shown, the first housing 102 consists of multiple functional elements, including the controller 201, which serves as the main processing arbiter for detection of interface connections and appropriate configuration of the RF core based upon the interfaces detected. The controller 201
25 also is responsible for directing communications between the onboard elements and the second housing item, as described with reference to FIG. 3.

The modulator 203, the wireless communications
30 element 204 and the demodulator 205 together comprise the RF section of the first housing 102. The Application Programmers Interface (API) element 221 is the standard programming interface that facilitates operation in non-traditional wireless communications devices, such as
35 personal computers or palmtop computers. The Authentication element 223 provides the logic necessary to ensure that the first housing 102 is authorized to operate with a specific second housing, as later described. The

human-interface interface 207 is comprised of a number of other elements. In a preferred embodiment, these elements include a display interface 216; a keypad interface 217; a speaker interface 218 and a microphone interface 219 (the latter two interfaces generally being referred to as audio interfaces). It should be understood that, as the need arises, other human-interface interfaces could be developed and are anticipated. The display interface 216 provides a means for controlling the display on the second housing. Similarly, the keypad interface provides a means for controlling the keypad on the second housing; the speaker interface 218 provides a means for routing audio between the first housing and a speaker in the second housing, if present; and the microphone interface 219 provides a means for connecting audio inputs, if present, from the second housing to an audio processor within the first housing.

As shown, the functional interface 209 includes an energy source interface 210; an antenna interface 211; a data port interface 212 and a power amplifier interface 213. Generally, the functional Interface 209 supports connections to external interfaces and to common functional interfaces in the second housing. For example, the energy source interface 210 might be used to provide power to the first housing by drawing power from the second housing. The antenna interface 211 is primarily a first housing interface that provides a connection between the RF section (203-205) and an air transmission medium (e.g., external antenna) located on the second housing. The data port interface 212 provides a means to connect an external computing device, or similar device supporting a compatible interface. These computing devices can either use the RF section (203-205) to transmit and receive data streams, or can simply use the data port interface 212 to act as a data port extension between the first and the second housing. The power amplifier interface 213 provides the proper RF signal to an external power amplifier, and thereby serves to extend the range of the RF section in relation to the supporting radio system

infrastructure. It should be noted that other functional interfaces could be added, and are anticipated by the present invention. For example, another interface might provide connection to one of number of other devices (e.g., a GPS receiver) that might be useful to the user of the present invention.

According to the invention, the human-interface interface 207 communicates with interface features of the second housing. That is, the display interface 216 connects to the display element on the second housing, which might, e.g., indicate to the user the current operational state and mode of the first housing. Likewise, the keypad interface 217 connects to the keypad element on the second housing, which allows the user to enter information or commands to operate various second housing functions. The speaker interface 218 provides an audio connection to the second housing's speaker, which audio might be derived from the first housing demodulator or controller or other first housing elements. The microphone interface 219 accepts audio from the second housing's microphone, which is then used as input to the controller and/or modulator of the first housing. Lastly, another human-interface interface (not shown) might be used to provide connectivity to various second housing peripherals, such as a dedicated button for access to functions defined by the API element 221, or a Push-To-Talk (PTT) switch, a quick function access button or the like.

The Application Programmers element 221 allows for the programming of specific functionality of the first housing. The API commands the controller regarding the operation of all the elements in the first housing, as well as how they are to interact with the second housing elements. The authentication element 223 determines the allowed operational state of the first housing in relation to the second housing. For example, it can be used to provide encryption services to the controller 201, modulator 203 and demodulator 205. The RF section (203-205) transmits and

receives radio frequency signals via the antenna interface 211, which is in turn connected to an external antenna on the second housing. It should be noted that the RF section could support various frequency bands using different radio frequency modulation types in each frequency band, as is known in the art.

Of course, the present invention anticipates that the first housing 102 can be inserted into a number of different second housings having various form factors and functional capabilities. These can range from dedicated function devices to devices suited to a multitude of applications. FIG. 3 shows one such specific application, where the second housing 302 comes in the form factor of a two-way radio, in accordance with a preferred embodiment of the invention. The second housing in this case might contain an external antenna 304, a display 306, a keypad 308, a microphone 310, a speaker 312, a PTT switch 314 and a power source (not shown). Once the two housings are mated, and after initialization takes place, the combined unit provides to the end user those functions typically provided by a two-way radio.

As shown in FIG. 4, the radio communications core 100 can also be mated with other housings that provide different functions. For example, when inserted into a second housing that includes external paging hardware and corresponding interfaces, the assembly is automatically configured as a pager 401. In this arrangement, the modulator and microphone interface of the first housing are disabled. Similarly, when inserted into a second housing that includes external cellular telephony hardware and corresponding interfaces, the assembly is automatically configured as a cellular telephone 402. In this arrangement, the full duplex RF section circuitry, as well as the microphone and speaker interfaces, are enabled. When the first housing is inserted into a second housing that includes external land-mobile radio hardware and corresponding interfaces, the assembly is

automatically configured as a two-way radio. In this arrangement, the duplex RF circuitry would be disabled, while the interface to the PTT switch is enabled.

5 Lastly, when the first housing is inserted into a portable or desktop computer form factor, having conventional computer hardware and corresponding interfaces, the assembly is automatically configured as a personal computer having RF connectivity capabilities. In a
10 preferred embodiment, the user can configure the first housing using pre-installed second housing profiles. For example, if the user selects a profile of a data-only radio, the first housing might disable all audio circuitry and keypad interfaces. A data path from the computer (i.e., second
15 housing) to the first housing is automatically configured and data is routed via the data port interface, as earlier described. Similarly, if the selected profile is that of a two-way radio, the computer display screen might replicate the functions of a two-way radio. In particular, these functions
20 would replicate the display, keypad and other indicators onto the screen. In addition, the computer's power, microphone and speaker interfaces could be connected with corresponding interfaces on the first housing.

25 FIG. 5 shows a flow diagram 500 depicting operation of a radio frequency (RF) communications core, in accordance with a preferred embodiment of the invention. The communications core user physically inserts (502) the first housing, which is in a sleep mode, into the second housing.
30 Upon insertion, the first housing is activated via power derived from an onboard battery or from a power source in the second housing. The controller of the first housing executes an authentication procedure to ensure that the first and second housing are functionally compatible and legally
35 licensed to operate together. A check (504) is then made to determine whether or not the authentication test is passed, whereby a failure results in the first housing reverting (506) back to the sleep mode. Upon passing the authentication test,

the controller determines (508) what physical connections have been made to the functional interfaces (209 shown in FIG. 2) of the first housing. The first housing controller then determines (510) the available interfaces of the second housing, using the human-interface interfaces (207 shown in FIG. 2). The available human interfaces on the second housing may be one or more of the elements shown in FIG. 3, e.g., speaker, microphone, display, etc.

After the interface testing, the first housing retrieves (512) it's operational preference profile, which might contain instructions to enable or disable a set of human-interfaces, avoid use of a particular mode and the like. After the profile is retrieved, the first housing controller then determines (514) whether the interface and modes of the two housings are matched and can perform the intended functions. If one or more of the modes or interfaces do not match, the first housing functions are disabled (506) and the first housing enters the sleep mode. If the first and second housing interfaces and profiles match, the first housing enables (516) the common interfaces and modes of operation and begins communication (518) with the desired RF system or systems. Such systems might include, but are not limited to, a GSM system, a trunked radio system, a data network or a cellular system. It should be noted that the common modes include the operational parameters of the combined housings, e.g., frequency, modulation type, subscriber ID, option configurations, etc. The user continues normal communication with the desired communication system until it is determined (520) that the first housing has been either removed or powered-down for any reason. If the first housing becomes uncoupled from the second housing, or if power is cut off from the first housing, the first housing functions are disabled (506) and the first housing enters the sleep mode.

With the present invention and ever-increasing packaging capabilities, common radio frequency (RF)

functions can be integrated into a singular, wireless communications core. These devices can be designed for interchangeability amongst various form factors. Depending on the form factor used, the communications core is able to adapt itself to an allowable and compatible configuration. According to the invention, the communications core can be inserted into a laptop, a two-way radio form factor, a cellular form factor or a paging form factor. Within each of these form factors, the core adapts itself to the desired communications format. The present invention enables users to purchase one communications core for deployment in a variety of form factors, depending on their specific communications needs. For example, when the user is seated at a desk, the core might be inserted into a desktop computer and an integrated display is presented to them to provide a number of functions. When that same user leaves the office, the RF communications core can be removed and inserted into a portable two-way radio form factor for use as dispatch radio device. In this manner, a single communications core, serving multiple communication functions, would help mitigate the chaos of maintaining and operating multiple, disparate communications devices.

What is claimed is:

Claims

1. A device, comprising:
- a first housing;
 - 5 - a modulator and demodulator disposed within the first housing;
 - a second-housing interface that is operably coupled to the first housing and that includes a human-interface interface;
 - a controller disposed within the first housing that is operably coupled to:
 - 10 - the human-interface interface; and
 - at least one of the modulator and demodulator;
- which controller selects a particular human-interface mode of operation from amongst a plurality of stored human-interface modes of operation to accommodate a particular second housing
- 15 human interface.
2. The device of claim 1, wherein the human-interface interface comprises a keypad interface.
- 20
3. The device of claim 1, further comprising authentication means, operably coupled to the controller, for determining whether a user is authorized to use the device.
- 25
4. The device of claim 1, further comprising application programming interface (API) means for configuring the device in accordance with the particular mode of operation selected.
- 30
5. The device of claim 1, further comprising wireless communication means for transceiving information with an external communication system.
- 35

6. A radio frequency (RF) communications core, comprising:

- a first housing having at least one RF shielding enclosure contained therein;
- 5 - a modulator and demodulator disposed within the at least one RF shielding enclosure;
- a second-housing interface that is operably coupled to the first housing and that includes a human-interface interface and a functional interface;
- 10 - a controller disposed within the first housing that is operably coupled to:
 - the human-interface interface;
 - the functional interface; and
 - at least one of the modulator and demodulator;
- 15 which controller selects a particular human-interface mode of operation from amongst a plurality of stored human-interface modes of operation to accommodate a particular second housing human-interface.

- 20 7. The RF communications core of claim 16, wherein the external communication system is a communication system selected from the group consisting of: a GSM system, a trunked system, a data network and a cellular system.

25

8. A method of providing wireless communications using a RF communications core that includes:

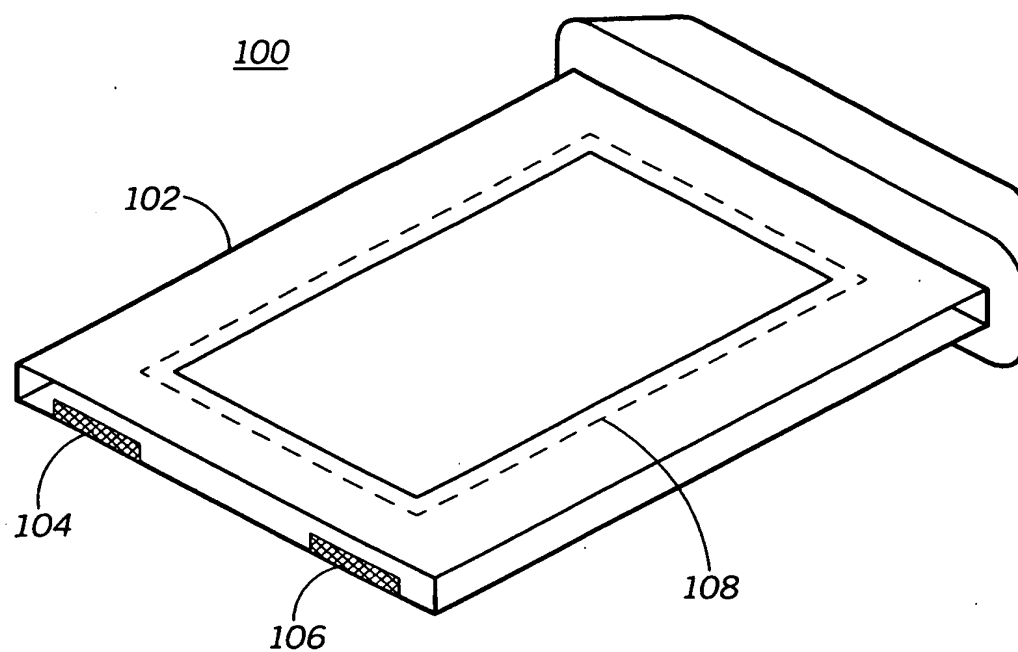
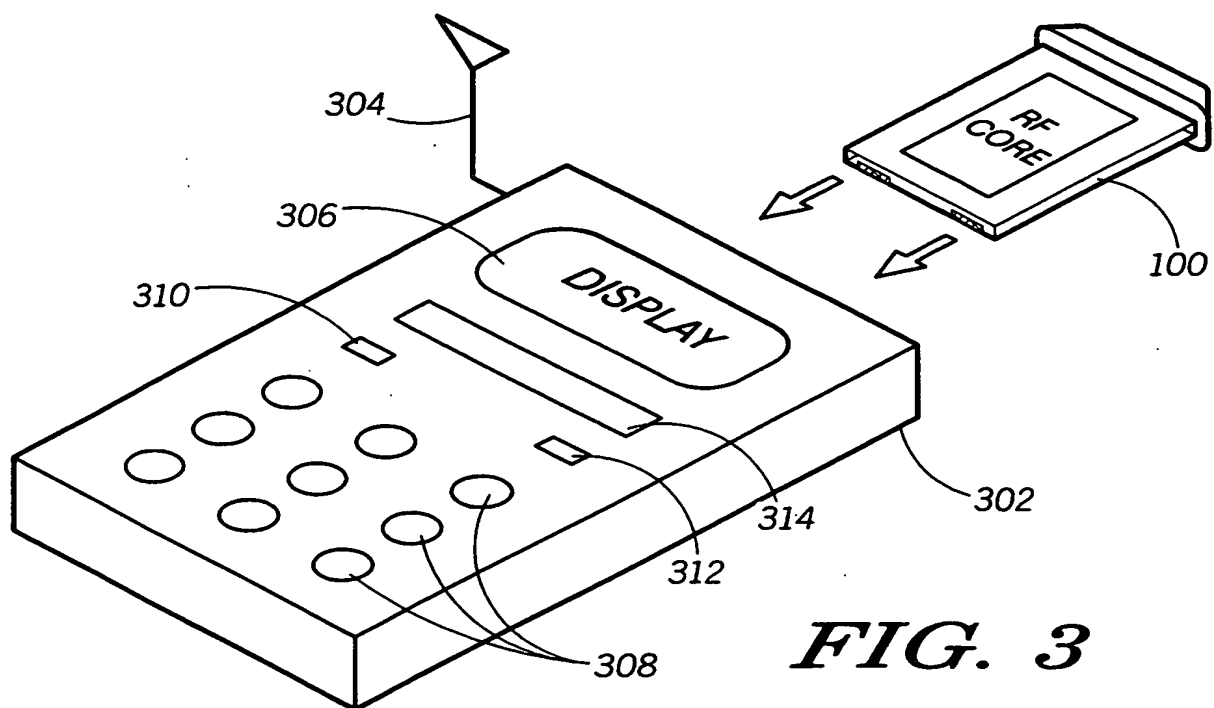
- a first housing having at least one radio frequency shielded enclosure contained therein;
- 30 - a modulator and demodulator disposed within the at least one enclosure;
- a second-housing interface that is operably coupled to the first housing and that includes a functional interface;
- 35 - a controller disposed within the first housing that is operably coupled to:
 - the functional interface; and
 - at least one of the modulator and demodulator;

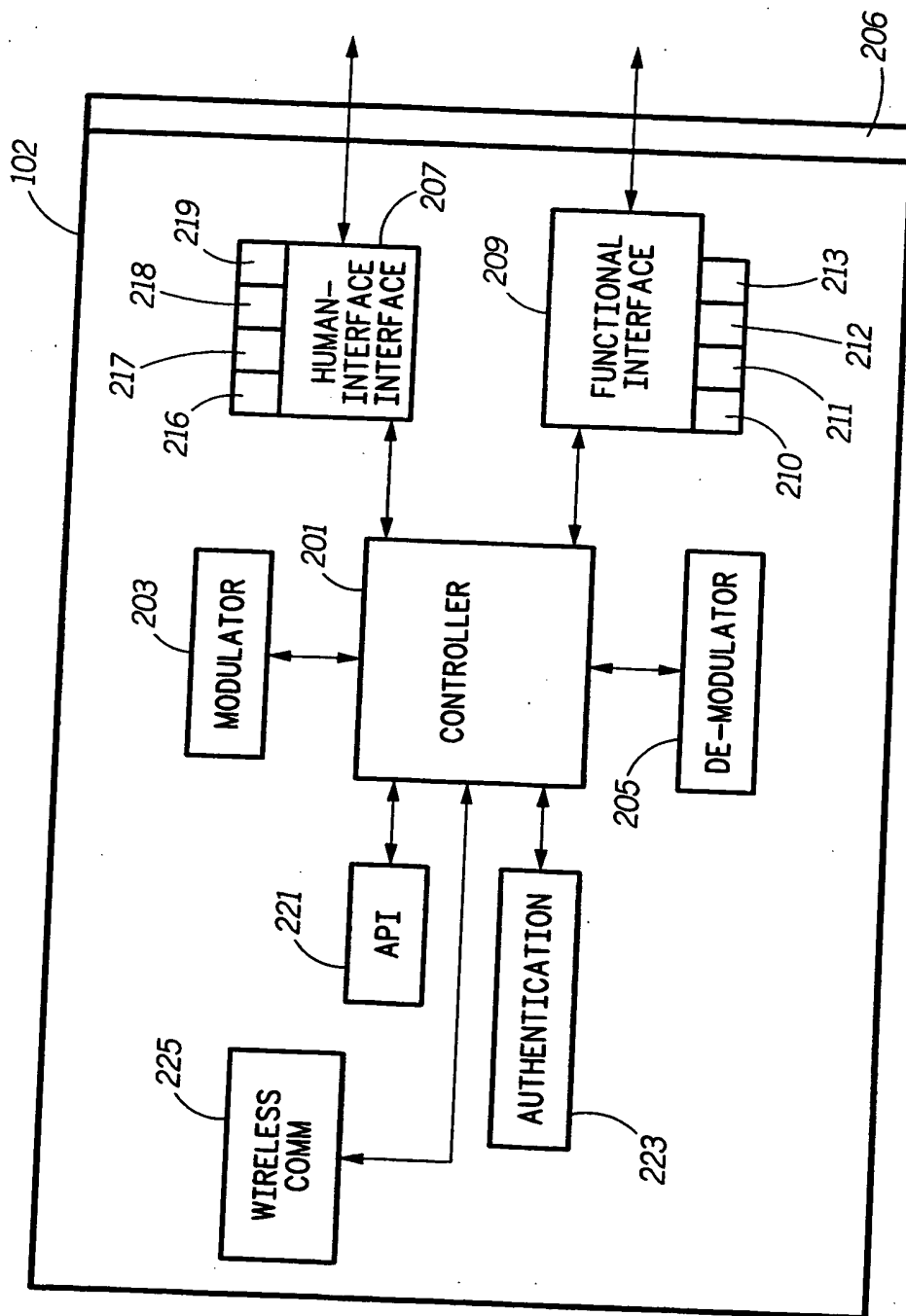
which controller selects a particular mode of operation from amongst a plurality of stored modes of operation to accommodate a particular second housing function-interface; the method comprising the steps of:

- 5 determining a human-interface mode of operation for the RF communications core; and
 using the controller to enable the RF communications core, based at least in part on the human-interface mode of operation.

10

9 . The method of claim 19, further comprising the step of determining whether the first housing and second housing are compatible for operation.

**FIG. 1****FIG. 3**



200

FIG. 2

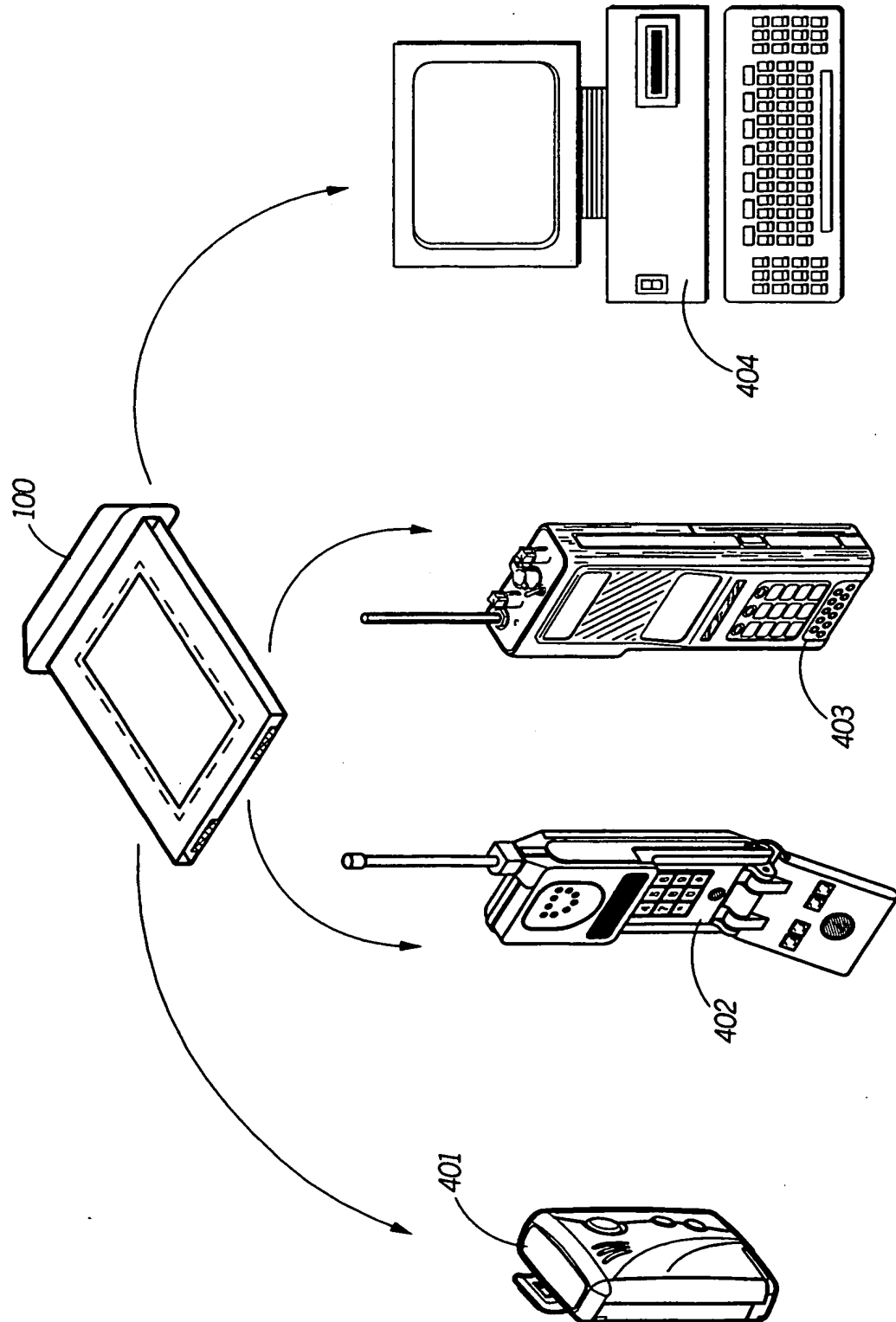
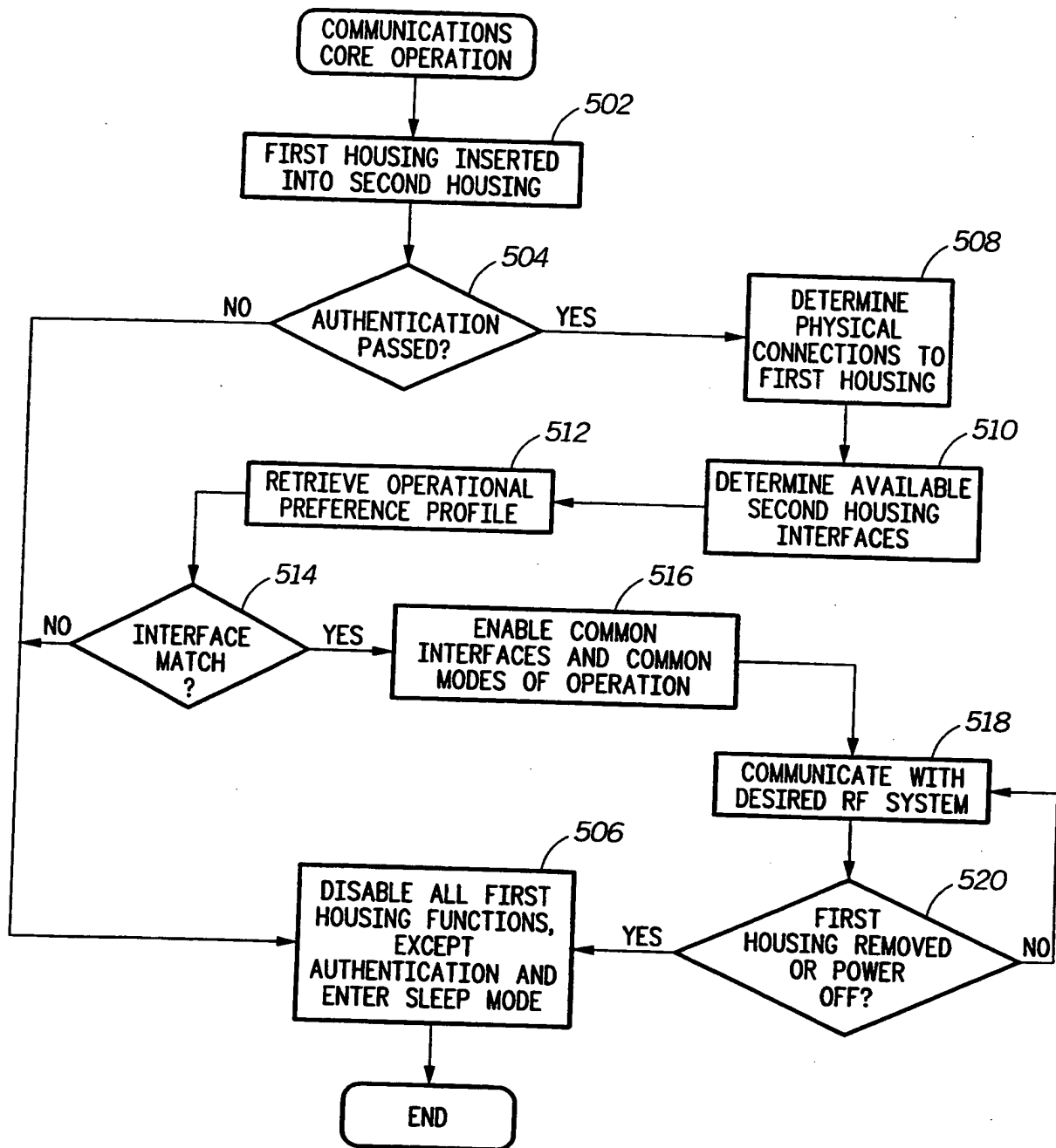


FIG. 4

4/4

500**FIG. 5**

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/14867

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : H04Q 7/32

US CL : 455/557

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 455/557

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,465,401 A (THOMPSON) 7 November 7, 1995, figures 2, 4, 7, and 10.	1-6, & 8



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Date of the actual completion of the international search

10 SEPTEMBER 1998

Date of mailing of the international search report

20 OCT 1998

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/14867

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 7 & 9
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
they depend on non-existing claims.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet(1))(July 1992)*